

CLAIMS:

1. Method for fabrication of a memory cell, for storing at least one bit, on a semiconductor substrate (2), comprising on said substrate (2) a first floating gate stack (A), a second floating gate stack (B) and an intermediate access gate (AG), said first and second floating gate stacks (A, B) comprising a first gate oxide layer (4), a floating gate (FG), a control gate (CG; CGL, CGu), an interpoly dielectric layer (8), a capping layer (6) and side-wall spacers (10), said first gate oxide layer (4) being located on said substrate (2), said floating gate (FG) being on top of said first gate oxide layer (4), said interpoly dielectric layer (8) being on top of said floating gate (FG), said control gate (CG; CGL, CGu) being on top of said interpoly dielectric layer (8), said capping layer (6) being on top of said control gate (CG; CGL, CGu), said memory cell further comprising source and drain contacts (22), said method of fabrication comprising:
- defining said first and second floating gate stacks (A, B) in the same processing steps to have substantially equal heights;
 - depositing a poly-Si layer (12) over said first and second floating gate stacks (A, B), said poly-Si layer being deposited in between said first and second floating gate stacks (A, B) in a thickness equal to or larger than the height of said first and second floating gate stacks (A, B);
 - planarizing said poly-Si layer (12) by chemical mechanical polishing to obtain a planarized poly-Si layer (14), using said capping layer (6) of said first and second floating gate stacks (A, B) as a polish stop layer;
 - defining said intermediate access gate (AG) in said planarized poly-Si layer (14) by a masking step with an access gate mask (20) over said planarized poly-Si layer between said first and second floating gate stacks (A, B) and an etching step for poly-Si.
2. Method for fabrication of a memory cell, according to claim 1, characterized by:
- forming on top of said intermediate access gate (AG) a first self-aligned silicide area (28) and on top of said source and drain contacts (22) a second self-aligned silicide area (26);

- forming on said second self-aligned silicide area (26) a local interconnect (30);
 - depositing on top of said local interconnect (30), said first self-aligned silicide area (28), and said capping layer (6) a pre-metal dielectric layer (32);
 - forming a contact opening (CO) in said pre-metal dielectric layer (32) to said
- 5 local interconnect (30);
- filling said contact opening (CO) with a metal contact (34) to said local interconnect (30); and
 - defining on top of said pre-metal dielectric layer (32) at least one metal line as a bit-line (40).

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3. Method for fabrication of a memory cell, according to claim 1, characterized by:

- forming on top of said intermediate access gate (AG) a first self-aligned silicide area (28) and on top of said source and drain contacts (22) a second self-aligned
- 15 silicide area (26);
- depositing on top of said second self-aligned silicide area (26), said first self-aligned silicide area (28) and said capping layer (6) a pre-metal dielectric layer (32);
 - forming a contact opening (CO) in said pre-metal dielectric layer (32) to said
- 20 second self-aligned silicide area (26);
- filling said contact opening (CO) with a metal contact (50) to said second self-aligned silicide area (26); and
 - defining on top of said pre-metal dielectric layer (32) at least one metal line as a bit-line (41), said bit-line (41) being slanted.

25 4. Method for fabrication of a memory cell, according to claim 1 or 3, characterized by:

- forming on top of said intermediate access gate (AG) a first self-aligned silicide area (28) and on top of said source and drain contacts (22) a second self-aligned silicide area (26);
- 30 - depositing on top of said second self-aligned silicide area (26), said first self-aligned silicide area (28) and said capping layer (6) a pre-metal dielectric layer (32);
- forming a contact opening (CO) in said pre-metal dielectric layer (32) to said second self-aligned silicide area (26);

- filling said contact opening (CO) with a contact (50) to said second self-aligned silicide area (26); and
- defining on top of said pre-metal dielectric layer (32) in a first metal level (metal-1) said bit-line (42) for connecting to said contact opening (CO), said bit-line (42) being slanted.

5 5. Method for fabrication of a memory cell, according to claim 4, characterized by:

- forming on top of said intermediate access gate (AG) a first self-aligned silicide area (28) and on top of said source and drain contacts (22) a second self-aligned silicide area (26);
- depositing on top of said second self-aligned silicide area (26), said first self-aligned silicide area (28), and said capping layer (6) a pre-metal dielectric layer (32);
- forming a contact opening (CO) in said pre-metal dielectric layer (32) to said second self-aligned silicide area (26);
- filling said contact opening (CO) with a contact (52) to said second self-aligned silicide area (26); and
- defining on top of said pre-metal dielectric layer (32) in said first metal level (metal-1) a landing pad (49) on top of said contact (52) for connecting to said contact opening (CO) by means of:
 - depositing an intermetal dielectric layer,
 - forming a further contact opening as a via opening in said intermetal dielectric layer,
 - filling said via opening with a contact (48) acting as a via, and
 - defining in a second metal level (metal-2) a further slanted bit-line (43) on top of said intermetal dielectric layer for connection to said contact (48) acting as a via, said contact (48) acting as a via being connected to said landing pad (49).

30 6. Method for fabrication of a memory cell, according to any of the preceding claims, characterized by:

- said floating gate FG consisting of a trapping medium,
- said trapping medium comprising an ONO layer stack, an oxygen-rich silicon layer, or a silicon dioxide layer comprising silicon nanocrystals dispersed therein.

7. Memory cell, for storing at least one bit, on a semiconductor substrate (2), comprising on said substrate (2) a first floating gate stack (A), a second floating gate stack (B) and an intermediate access gate (AG), said first and second floating gate stacks (A, B) comprising a first gate oxide layer (4), a floating gate (FG), a control gate (CG; CGl, CGu), an interpoly dielectric layer (8), a capping layer (6) and sidewall spacers (10), said first gate oxide layer (4) being located on said substrate (2), said floating gate (FG) being on top of said first gate oxide layer (4), said interpoly dielectric layer (8) being on top of said floating gate (FG), said control gate (CG; CGl, CGu) being on top of said interpoly dielectric layer (8), said capping layer (6) being on top of said control gate (CG; CGl, CGu), said memory cell further comprising source and drain contacts (22), characterized in that
- said first and second floating gate stacks (A, B) have substantially equal heights;
 - said intermediate access gate (AG) comprises a planarized poly-Si layer (14) in between said first and second floating gate stacks (A, B).
8. Array of memory cells, characterized in that said array comprises at least two adjacent memory cells (C, D) according to claim 7.
9. Array of memory cells according to claim 8, characterized in that
- said at least two adjacent memory cells (C, D) are arranged in a virtual ground arrangement; and
 - in said virtual ground arrangement a bit-line is a metal line (40; 41; 42; 43); said bit-line being connected to said second self-aligned silicide area (26) by a contact (30; 34; 50; 50; 48, 49, 52) in said contact opening (CO).
10. Array of memory cells according to claim 9, characterized in that in said array of memory cells at least two memory cells connect to said contact opening (CO) for said bit-line (40; 41; 42, 43).
11. Array of memory cells according to claim 8, characterized in that said at least two memory cells are programmed selectively by Source-Side-Injection, and said at least two memory cells are erased by Fowler-Nordheim Tunneling or by Hot Hole Injection.

12. Array of memory cells according to claim 8, characterized in that said at least two memory cells are programmed selectively by Fowler-Nordheim Tunneling, and said at least two memory cells are erased by Fowler-Nordheim Tunneling or by Hot Hole Injection.

5 13. Array of compact memory cells according to claim 10 or 11 or 12, characterized in that said bit-line (41) is slanted and connected to memory cells, which are not "horizontally" neighboring cells having the same control gate (CGu, CGI).

10 14. Array of compact memory cells according to claim 10 or 11 or 12, characterized in that

- in a first metal deposition process level (metal-1) said bit-line as a metal-1 bit-line (42) comprises a plurality of first line parts (44) running in a direction parallel to said active lines and a plurality of second line parts (45), each of said first line parts (44) being formed on top of one of said contacts (50), said second line parts (45) being formed in
- 15 between said contacts (50), and
- in a second metal deposition process level (metal-2) said bit-line as a metal-2 bit-line (43) comprises a plurality of first line parts (44) running in a direction parallel to said active lines and a plurality of second line parts (45), each of said first line parts (44) being formed on top of one of said contacts (48) acting as a via, said second line parts (45) being
- 20 formed in between said contacts (48) acting as a via;
- said bit-line (42, 43) running step-wise for connecting to memory cells, which are not "horizontally" neighboring cells having the same control gate (CGu, CGI), with each of said second line parts (45) running in a direction perpendicular to said active lines or running in a slant direction relative to said active lines.

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15. Semiconductor device comprising at least one memory cell according to claim 7.